Renewable Energy 132 (2019) 381–393

Contents lists available at ScienceDirect

Renewable Energy

journal homepage: www.elsevier.com/locate/renene

Factors influencing the electricity generation preferences of Turkish citizens: Citizens' attitudes and policy recommendations in the context of climate change and environmental impact

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ARTICLE INFO

Article history:
Received 21 October 2016
Received in revised form
28 July 2018
Accepted 1 August 2018
Available online 4 August 2018

Keywords:
Electricity generation preferences
Energy policy
Renewable energy
Climate change
Nuclear power plants

ABSTRACT

Drawing on the findings of a survey on Turkish citizens' energy preferences, the aim of this study is to propose policy recommendations on Turkey's energy policies. To realise this aim, this study analyzes the attitudes and behaviours of the citizens of Turkish Republic concerning their preferences on electrical energy generation. This article scrutinizes the preferences of citizens on nuclear power plants (NPPs) and renewable energy sources (RES)-based power plants. Moreover, taking into consideration the issues of global warming and climate change, the article provides a separate analysis of how recent developments in these two issues affect citizens' preferences on electrical energy generation.

Findings of the study indicate that a vast majority of Turkish citizens are against the establishment of NPPs in the country. The first choice in electricity generation is RES. RES endorsers state that RES-based power plants will result in no environmental problems and that they are willing to pay more for electricity in case of an increasing reliance on RES-based electricity generation. A vast majority of the respondents think that the prime consideration in electricity generation should be its effects on climate change.

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1. Introduction

Up until the 1970s, energy policies were treated as a technical issue outside the sphere of public discussion. With the first severe oil crisis in 1973, energy issues attracted the interest of the public, and public opinion started to influence energy policies. Citizens' energy preferences became an important factor that needed to be taken into consideration before making energy investments since they were seen as important for successful realisation of energy projects [1–3]. Opinion polls and studies on citizens' energy preferences gained importance in various, albeit not all, parts of the world.

So far, three studies have been carried out on the formation of Turkish citizens' energy preferences [1,4,5]. Greenpeace [4] and BBC [5] studies are opinion polls. The BBC study, which consists of a two-question survey, does not include items on citizens' knowledge of climate change and environmental issues and their concerns and attitudes in relation to these issues. Although it is more comprehensive, Greenpeace study focuses on nuclear energy and nuclear power plants (NPPs), but it lacks detailed items on citizens' knowledge, attitudes, and concerns in relation to climate change and environment. It can be said that the descriptive statistical study carried out by Ertör et al. [1] is the first comprehensive research on Turkish citizens' electrical energy generation preferences.

Changes in citizens' energy preferences resulting from new developments should be discussed by studies carried out in the new conjuncture. This study differs from the studies carried out heretofore in terms of the conjuncture in which its data were collected and the scope and content of the survey it deployed for data collection. This study was carried out at a time when Turkey's long-planned NPP projects were initiated and NPPs attracted the interest of the public. Fukushima nuclear accident in Japan raised doubts about nuclear safety all over the world. After the accident, many countries started discussing NPPs and some decided to phase out existing NPPs or not to establish any new ones. While little was known in 2007 about the nuclear technology that was to be preferred and the companies to set up and run the NPPs, these are known today, and therefore this study has been able to include the issue of "trust". Turkey is located in a conflict zone with a high risk

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https://doi.org/10.1016/j.renene.2018.08.006
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of war that has considerably escalated recently. Considering the recent conjuncture, the study has included the effect of citizens' NPP preferences on their views on nuclear security and nuclear proliferation.

In such a context, this study presents policy makers with up-to-date data that can assist them with revisiting their decisions and consider tapping into the country's rich renewable energy potential, which is not adequately exploited in Turkey. The study was designed considering that the survey would be conducted four years after the Fukushima accident and therefore responses of citizens would be more informed and less likely to be influenced by their emotional state in the aftermath of the accident. The experience of Fukushima accident and increasing shares of renewable energy sources (RES) in Turkey are among the changes that have taken place since 2007. The period when the data were collected concurred with the intensification of citizen protests against hydroelectric power plants, increases in the installed capacity of RES, and accumulation of experience and knowledge on these resources. The use of coal-fired power plants for electricity generation was one of the most controversial topics of the debates on environment and climate change. The study described in this article analyzes the changes in citizen preferences in the face of the new conditions and includes detailed items on knowledge of and attitudes concerning climate change and global warming.

The cities to implement the survey were determined according to certain criteria. Some of these cities have relatively high reliance on RES while some others are known for their opposition to hydroelectric power plants (HPPs). All Turkish cities where NPP construction plans were underway are included in the survey and Istanbul has been included since it is a metropolis.

Survey questions are novel questions that have been formed as a result of the interviews carried out by various stakeholders involved in the issue and a pilot survey that was carried out with 30 respondents.

Analysing survey findings and the energy policies of various countries, the aim of this study in general is to come up with policy recommendations for energy policy makers. More specifically, the objective of the study is to answer the following questions:

- What are the opinions of the participants on Turkey's electricity generation policies?
- What are their perceptions in relation to utilising NPPs and RES-based power plants?
- What kind of relationship do they think exists between different types of power plants and environmental problems such as climate change and global warming?
- How do their preferences for different types of electricity generation power plants vary? In particular, what kind of power plants do they prefer the most for electricity generation and what are the reasons for them preferring particular types of power plants to others?
- What kind of energy policies can be recommended based on the findings of the study? What are the issues that need to be taken into consideration during the implementation of these policies?

2. Studies on citizens' electrical energy preferences around the world and in Turkey

There is a large body of scholarship on citizens' electrical energy preferences, attitudes, and the factors that determine these attitudes. Studies involving fieldwork carried out in different countries [1,4–8] report a high level of opposition to NPPs. Studies carried out in 2011, after the Fukushima accident, show that there is a strong opposition to NPPs in countries that have operational NPPs such as Germany and Japan.

Opposition to NPPs is related to high levels of concern for the environment, possible threats for future generations, and risks associated with nuclear proliferation and accidents [1,4,6]. Also, local populations oppose the construction of NPPs in their neighbourhood, which is often related to the public perception of "not-in-my-back-yard" (NIMBY) syndrome [4,9].

Studies show that concerns for climate change and energy supply security are significant determinants of nuclear endorsement [1,6,10]. A large majority of citizens who endorse NPPs provide conditional support. When respondents in this group are provided with RES as an alternative, their endorsement level of NPPs decreases while that of RES increases. Studies report differences in endorsement levels depending on gender [8,11], age [6,8,11], social class [6], concern for environment [6], education [4], share of nuclear energy in total power generation [12], and immediate economic benefits to the local community [13].

Nuclear accidents exacerbate citizens' negative views on NPPs [8,9,12–14]. A sudden negative shift in public perception towards nuclear is observed in the immediate aftermath of nuclear accidents [8,9,14].

Factors that influence public perception of NPPs are education, media, political views, information shared with the public, and attitudes of state authorities towards energy sources [9,11,12,15,16].

Studies report a high level of citizen support for RES [1,4,5,7,8,10,11,16,17]. High preference rate for RES is related to the perceived need for combating climate change, increasing local employment, and ensuring energy supply security [1,2,4,7,8,10,18]. Level of support for RES can change depending on gender [8,11,18], age [11,18] and income [18]. Also, attitudes towards RES depend on the type of the renewable energy to be used [16,18].

In the aftermath of NPP accidents renewable energies are the first choice in dealing with climate change and ensuring energy supply security due to the significant changes taking place in perceived risks and benefits [8,14,17].

Citizens regard climate change and global warming as threats to their lives and report these two phenomena as the main reasons for their endorsement of NPPs [1,6,8,10]. Studies report increases in willingness to pay (WTP) for increased RES-based generation instead of building NPPs [1,9,18,19]. Reported level of trust in state institutions is low in the case of WTP [19] and the need to obtain information in the aftermath of a nuclear accident [4].

An analysis of energy policies in Germany, Spain, Denmark, and Japan shows that these countries are turning to RES-based electricity generation in order to ensure energy supply security, mitigate climate change, prevent further destructive effects of fossil fuels on environment, and phase out NPPs [20–26].

Germany has set an example for many countries with its successful and sustainable electrical energy generation policies [22,24–26]. RES-based energy policies of Germany were modeled after by Japan in 2012 and significant increases in installed power were reported in PV sector [22,27]. An analysis of the energy policies of the countries that transition into RES, Germany in particular, reveals that the most efficient and effective RES-based electricity generation incentive mechanism is the source-dependent and long-term feed-in-tariff (FiT) mechanism. Moreover, FiT levels have been constantly updated in the light of the developments in installed power of RES and experiences that have accumulated over time. In these countries, FiT mechanism is implemented along with a set of complementary policies such as research & development (R&D) and innovation subsidies, investment incentives, tax exemptions, grid access support, and emissions trading system.

Energy policies are shaped by various factors such as energy supply security, environment and climate policies, and economic and industrial priorities. Ensuring active participation of

stakeholders, public support for RES, and addressing citizens' reservations about NPPs are also crucial in successful transition to RES. Source consumption targets and work on electricity generation expansion planning have contributed to the increase in installed RES potential [21–26].

3. Turkey's energy policy

Turkey had a total installed power of 32.8 MW in 1923, the year when the Republic was established. Through coal-fired electricity generation between 1923 and 1950, this figure reached 407.8 MW. The period between 1950 and 1970 was a time when both the state and the private sector were involved in the construction and running of power plants and HPP investments were initiated along with fossil-fueled power plants. By 1970 the total installed power of Turkey had reached 2234.9 MW, and installed power of HPPs accounted for 725.4 MW of this amount.

The severe oil crisis that began in the 1970s seriously affected Turkey's energy sector as it did all over the world. The oil crisis and the increase in Turkey's oil consumption contributed to the widening of current deficit, triggering as a result a major economic crisis. Increased reliance on imported fossil fuels, which had already accounted for the greatest share in energy production portfolio, further disrupted the supply-demand balance, resulting in energy supply restrictions.

Installed power of HPP increased in the period between 1970 and 1980. In 1980, hydropower accounted for 2130.8 MW of the 5118.7 MW total installed power. The period encompassing 1984–1992 witnessed pivotal structural changes and the liberalisation of the electricity market was initiated with Build-Operate-Transfer (BOT) and Build-Operate (BO) financing models.

The monopoly of Turkish Electricity Institution (TEK) was abandoned in 1984, when private companies were allowed to engage in the production, transmission, and distribution of electricity. It was also in 1984 that geothermal plants entered the energy production market. Total installed power of Turkey, which was 8461.6 MW in 1984, increased more than twofold in less than a decade, amounting to 18716.1 MW by 1992. Thermal power plants had the largest share in electricity production in 1992 while HPPs accounted for the 45% of the total installed power. In the 1990s, a rapid increase took place in natural gas utilisation since it was cheaper and thought to cause less environmental damage. While the share of natural gas in electricity generation portfolio was only 0.2% in 1985, it increased over the years and reached 16% in 1992. The process of restructuring and liberalisation of electrical energy sector gained momentum between 1992 and 2001. In 2001, competitive free market model was adopted. The share of natural gas in electricity generation increased from 16% in 1992 to 40s% in 2001 [28].

Growing share of natural gas in electricity generation raised concerns over reliance on foreign energy sources, as a result of which energy supply security was placed high on the agenda. In the period between 2000 and 2016, there was an increase in the installed power of non-hydro RES plants. Their share in total installed power increased from 0.2% in 2000 to 10% in 2016. Turkey's total installed power had reached 85,200 MW by the end of 2017 [28,29].

Turkey is heavily dependent on fossil fuels for its electricity generation and primary energy consumption. The share of fossil-fueled power plants in electricity generation has maintained its upward trend, increasing from 50% in the total production in 1980 to 70s% in 2017 [28,29].

Turkey's current energy strategy is based on energy supply security. As part of this strategy, Turkey has pursued a strong commitment to utilisation of its entire domestic coal resources, tapping into RES, installing NPPs for electricity generation, and utilising imported coal in ways that do not pose a risk for energy supply security [30–32]. Turkey aims to tap into all its available hard-coal and lignite resources (60 TWh) until 2023 for electricity generation. It has been stated that with growing utilisation of domestic and RES the share of natural gas in electricity production will drop below 30%. The Ministry of Energy and Natural Resources (MENR) stated in its 2015–2019 Strategic Plan that their goal is to reduce the share of natural gas in electricity generation to the levels around 38% by the end of 2019. As for NPPs, the Ministry states that their target is at least %5 until 2020 and this will be gradually increased in the long run. However, this target was revised in the 2018 budget of the government, the target share for NPPs in Turkey's electricity generation was set as a minimum of 10%. While Turkey does not have any installed NPPs at the moment, a set of intergovernmental agreements have been signed to build NPPs, and the construction of Akkuyu NPP has recently started.

The central aim is to make renewables to have a share of at least 30% in Turkey's electricity generation by 2023. It is projected that Turkey's consumption of electrical energy will have risen to 424 TWh by 2023, and it is planned that 159 TWh of this amount will be generated by RES installed power of 61,000 MW. As part of this plan, by 2023 the government aims to utilise 34,000 MW of hydropower potential that can be of technical and economic value. The government set installed capacity targets for 2023 as 20,000 MW for wind power, 1000 MW for geothermal, and 1000 for biomass.

Electricity Market and Security of Supply Strategy Paper that was published in 2009 states that the goal is to ensure utmost utilisation of Turkey's potential for solar power. As a result of positive developments concerning solar power, 2023 installed capacity target for solar energy was set as 5000 MW in the National Renewable Energy Action Plan that was published in 2014. According to this target, 30% of electricity would be generated from RES in 2023. However, 2017 figures show that the share of renewable energy in electricity generation accounts for 30% today. One might think that 2023 objectives have already been attained, but it should be remembered that the share of hydropower in electricity generation is 20% while non-hydro RES with rich potential are not adequately utilised [30–33]. Relying on 2017 installed power figures, attainment levels of 2023 objectives for each RES have been estimated. According to this estimation, attainment levels in 2017 are as in the following: 80.188% for hydropower, 32.376% for wind, 68.160% for solar, and above 100% for geothermal.

Although Turkey's average CO_2 emission per person is below world averages, its greenhouse gas (GHG) emissions have shown a rapid increase [34–37] and increased reliance on RES would significantly contribute to a decrease in this trend. Turkey's rich RES potential is seen by many as a crucial source that must be tapped into in order to deal with the country's environmental and energy-related problems.

2015–2019 Strategic Plan published by MENR in November 2017 includes the following comments on RES utilisation in Turkey: "We have substantial potential in terms of both electricity and heat generation in RES such as solar, wind, hydro-electric, geothermal, biomass, wave and tidal. However, in order to accomplish utilisation of this potential fully, financial opportunities should be improved, legislation should be updated and transmission infrastructure should be strengthened; further more investor awareness should also be increased."

Electricity generation from wind and solar power has inevitably grown worldwide due to the declining technology costs, and Turkey is no exception considering high growth levels in electricity generation from wind and solar in 2017. A 2018 report published by

SHURA Energy Transition Center in coordination with Turkish Electricity Transmission Corporation (TEIAS) shows that Turkey can generate 20% of its total electricity from its wind and solar power plants with an installed capacity of 20,000 MW by 2026 without negatively impacting transmission system [38].

Turkey has been promoting RES since 2005. There have been various amendments to the legislation, which largely rests on FiT, and it is still in effect today. With the amendments made in 2016, RES Zones were identified and auction system was introduced. In line with the new system, Turkey held auctions for 10,000 MW of solar and 10,000 MW of wind power plants. Prices offered in both auctions were lower than those given by the official RESM and average market prices. It is thought that auction system will decrease energy production costs in the long run.

4. Survey

This section explains the method of the study, the population and sample, the development of data collection instrument, and data collection and analysis procedures.

4.1. Method

This quantitative study deploys a survey model, which is commonly used by studies aiming to describe the attitudes, opinions, behaviours, or defining characteristics of a particular research sample or entire population as they are [39].

Various statistical analysis methods have been used in the analysis of data obtained from respondents. In order to identify statistically significant differences between the variables, independent sample *t*-test was utilised in items involving two variables. Anova test, which is used to understand whether a statistically significant difference exists between more-than-two sets of variables [39–41], was used in order to analyse such kind of variable sets. Anova with Games-Howell Post Hoc Test was used in cases where variances of responses were not homogeneously spread, while Anova with post-hoc Tukey was used when variances were homogeneously spread [42,43]. Homogeneity of variance test was used in order to determine whether responses of research participants were homogenous [44]. Results of the test show that variances are not homogenously spread when the value $p < 0.05$ is obtained. If the analysis yields $p > 0.05$, variances are homogenously spread. Descriptive tests were used in order to identify the distribution of the responses based on variables. As descriptive tests, chi-square and frequency analysis were used. Chi-square test was used in order to analyse the distribution of the responses obtained through Likert scale. $p < 0.05$ indicates that responses are normally distributed and therefore a statistically significant difference exists between the dependent and independent variables. If $p > 0.05$, responses are not normally distributed, and therefore no statistically significant difference exists between the variables [40,45]. Frequency analysis was used in order to present the findings in tables and figures.

4.2. Population and sample

The respondents of this study were selected among Turkish citizens aged over 15 through stratified sampling method. The study was administered in eight cities, which were Artvin, Izmir, Balikesir, Manisa, Mersin, Sinop, Kirklareli and Istanbul. A total of 1290 respondents, 485 females and 805 males, participated in the survey.

4.3. Data collection instrument

This study uses a survey designed by the researcher. Firstly, a preliminary survey form was shown to university professors, representatives from professional organisations and relevant NGOs, and then was revised in the light of their feedback. After that, it was piloted with 30 people from different cities and demographic backgrounds. The survey was administered face-to-face in the piloting phase in order to see how respondents reacted to the questions. After the pilot study, the survey was revised into its final form.

4.4. Data collection and analysis

The pilot study carried out with 30 people was conducted in May 2014. The survey was administered to 1340 people from June 2014 to June 2015. 50 of the questionnaires were invalid as they had missing values. Data from the remaining 1290 questionnaires were statistically analysed via SPSS-20 software program.

5. Findings

This section presents the findings obtained as a result of the statistical analyses of the data.

5.1. Demographic characteristics of the research participants

Table 1 presents demographic information on research participants.

5.2. Preferences on electricity generation

This section explains the preferences of respondents on what kind of energy sources should be used in meeting Turkey's electricity demand.

Majority of the respondents think that Turkey's domestic sources (such as coal) and non-hydro RES are not adequate in order to meet the electricity demand of the country while they think that “using only RES” is adequate in meeting the electricity demand (51.17%). Frequency analysis results show that the respondents believe that RES-based power plants such as wind and solar power plants should be given the highest priority in decreasing foreign energy dependency. These are followed by HPPs, NPPs, and coal plants. Majority of the respondents (69.40%) stated that “the effect of electricity generation on climate change should be the prime consideration” in electricity generation.

5.3. Nuclear energy

This section discusses the conditions under which the perceptions of the respondents regarding the construction of NPPs are shaped.

Table 2 shows the distribution of the responses given to the question “Do you endorse the construction of an NPP in Turkey?”

As can be seen in Table 2, a large majority of the respondents (70.20%) oppose the construction of an NPP in Turkey while only 18.90% of the respondents endorse it. Opposition rate was 75.33% among the respondents in Mersin, where an NPP was in the process of construction by the time of this study.

In order to find out if there is a relationship between the demographic characteristics of the respondents and endorsement of the construction of NPPs in Turkey, various tests were conducted. Responses were elicited through a three-level Likert Scale (Yes, I endorse; I do not have an idea; No, I do not endorse). T-test results also show that women are more likely to oppose NPP construction

Table 1
Demographic information on participants.

		Freq.	%			Freq.	%
Gender	Female	485	37.60	Monthly household income	1000 TRY and below	201	15.58
	Male	805	62.40		1000 - 2000 TRY	398	30.85
Age	15–18	319	24.73		2001 - 3000 TRY	370	28.68
	19–24	216	16.74		3001 - 4500 TRY	151	11.71
	25–40	373	28.91		4501 TRY and above	170	13.18
	41–54	275	21.32	City of residency	Artvin	149	11.55
	55+	107	8.29		Balıkesir	71	5.50
Education	Literate	11	0.85		İstanbul	316	24.50
	Primary	63	4.88		İzmir	198	15.35
	Middle school	159	12.33		Kırklareli	109	8.45
	High school	462	35.81		Manisa	67	5.19
	College	470	36.43		Mersin	227	17.60
	Master	83	6.43		Sinop	153	11.86
	PhD.	42	3.26				

Table 2
NPP endorsement rates.

	Number of Respondents	Yes, I endorse.	No, I do not endorse.	I do not have an idea.
		(%)		
Turkey	1290	18.90	70.20	10.90
Mersin	227	15.86	75.33	8.81
Sinop and Kırklareli	262	20.23	72.90	6.87
Mersin, Sinop and Kırklareli	489	18.20	74.03	7.77

than men (Table 3).

According to Table 3, there is a significant relationship between age and nuclear endorsement. A significant difference can be observed between the age groups 15–18 and 41–54 and 55+. Respondents aged 15 to 18 are found to endorse NPP construction more than the respondents aged 41 to 54 and those over 55. In a similar vein, the rate of those who are uncertain about NPP construction is higher for 15–18 age group compared to 41–54 and 55 + groups.

As can be seen in Table 3, income is not a significant determinant of NPP endorsement or opposition.

41.39% of the 244 respondents who endorse NPP construction in Turkey are against the construction of an NPP in their neighbourhood. The percentage of the respondents who do not have an idea about this issue is also high (18.44%). 40.98% of the endorsers of NPPs in Turkey think that the nuclear energy policy followed by country's rulers is right. 31.97% of the respondents do not have an idea on this issue, which is higher than the rate of the respondents who find the nuclear policy followed by the country's rulers wrong (27.04%).

Table 4 presents the relationship between the respondents' preference for NPP construction in Turkey and their opinions on different aspects of NPPs. Responses to the question "Do you endorse the construction of a nuclear power plant in Turkey?" were elicited through a three-level Likert Scale. Responses to the first three statements given in Table 4 were elicited through a five-level Likert Scale. The fourth statement is a yes-no question. Responses to the fifth statement were elicited through a descriptive rating scale (respondents selected one of the options.)

As chi-square test results presented in Table 4 show, there is a significant but negative relationship between one's nuclear endorsement and their perceived effect of nuclear accidents such as Chernobyl and Fukuskima on one's nuclear endorsement attitude. An overwhelming majority (80.46%) of the respondents who opposed NPPs stated that Chernobyl and Fukushima accidents affected their views on NPPs negatively.

There is a statistically significant relationship between NPP endorsement and the belief that NPPs will decrease foreign energy dependence (Table 4). A large majority (73.70%) of the respondents who endorse building NPPs in Turkey think that foreign energy dependence will decrease thanks to NPPs. 60.90% of the respondents who oppose NPP construction in Turkey do not think that NPPs will decrease foreign energy dependence.

Table 4 shows that a statistically significant relationship exists between NPP preferences and views on the likelihood of the emergence of a nuclear proliferation risk. 47.60% of the respondents who endorse NPP construction in Turkey disagree with the idea that NPPs might give rise to a nuclear proliferation risk. 69.80% of the respondents who oppose NPPs agree that NPP construction might result in nuclear proliferation risk.

As can be seen in Table 4, opposition to NPPs is higher among the respondents who think that domestic (coal) sources and RES (such as wind, solar etc.) are adequate for meeting Turkey's energy demand than among those who disagree.

Chi-Square test results presented in Table 4 suggest that there is a statistically significant relationship between NPP endorsement

Table 3
Tests carried out to determine the interplay between the demographic characteristics and NPP endorsement rates.

	"Do you endorse the construction of a nuclear power plant in Turkey?"		
	Tests	Results	Comments
Gender	*t*-test	$p < 0.05$ (Mean for females 2.67, standard deviation 0.652, standard error rate 0.03. Mean for males 2.42, standard deviation 0.854, standard error rate 0.03).	Statistically significant difference
Age	Homogeneity of variance test	$p < 0.05$	Variances are not homogeneously spread.
	ANOVA with Games-Howell Post Hoc Test	$p < 0.05$	Statistically significant difference
Income level	Homogeneity of variance test	$p > 0.05$	Variances are homogeneously spread.
	ANOVA with post-hoc Tukey	$p > 0.05$	Not statistically significant

Table 4
Tests conducted to determine the reasons for NPP endorsement.

	"Do you endorse the construction of a nuclear power plant in Turkey?"		
	Tests	Results	Comments
"Chernobyl and Fukushima disasters have changed my ideas on nuclear power plants in a negative way."	Chi-Square	$p < 0.05$	Statistically significant distribution
"Nuclear power plants would decrease Turkey's foreign energy dependence."	Chi-Square	$p < 0.05$	Statistically significant distribution
"Construction of nuclear power plants would give rise to the risk of nuclear proliferation"	Chi-Square	$p < 0.05$	Statistically significant distribution
"Do you think Turkey's domestic (such as coal) and renewable energy (such as wind, solar etc.) sources are adequate in order to meet the electricity demand of the country."	*t*-test	$p < 0.05$ (Mean for the respondents who replied "YES": 2.63, standard deviation: 0.712, standard error rate: 0.031. Mean for the respondents who replied "NO": 2.44, standard deviation: 0.835, standard error rate: 0.03.	Statistically significant difference
"Which one of the following do you think should be the prime consideration in electricity generation?"	Chi-Square	$p < 0.05$	Statistically significant distribution

and opinions on what should be the prime consideration in electricity generation. 43.90% of the respondents who endorse NPP construction in Turkey think that "The effect of electricity generation on climate change should be the prime consideration", and 41.80% think that "reducing foreign energy dependence should be the prime consideration". The majority (55.00%) of the respondents who do not have an idea on NPP construction in Turkey think that climate change should be the prime consideration while 30% think that "reducing foreign energy dependence" should be the prime concern. 78.50% of the respondents who oppose NPPs in Turkey think that climate change should be the prime consideration in electricity generation.

Results show that the most important reason for endorsing NPP building in Turkey is that developed countries have NPPs while the second ranked reason is the perceived inadequacy of RES in meeting the electricity demand of Turkey. Environmental and safety concerns are the most important reasons for opposing NPP construction. Majority (66.6%) of the respondents who oppose building NPPs in Turkey would not change their opinion in case nuclear waste were to be disposed of outside the country.

5.4. Renewable energy

This section presents the opinions of the respondents on using RES in electricity generation.

A Chi-square test was carried out between the question "Which one of the following do you think should be the prime consideration in electricity generation?" and the statement "Using only renewable energy resources is adequate in meeting electricity demand." Test results are presented in Table 5.

Total frequency of the respondents who both think that "The effect of electricity generation on climate change should be the prime consideration" and select "totally agree" or "agree" for the statement "Using only renewable energy sources is adequate in meeting the electricity demand" is 508. This frequency will be defined in the subsequent sections as "RES endorsers" and will refer to the frequency number of the "respondents who prefer 100% reliance on RES". RES endorsers constitute 40% of the total number of the respondents.

32.48% of the RES endorsers are in the 25–40 age group while % 24.41 are in the age group 41–54. This is followed by 15–18 age group, with a rate of %17.91, and then by 19–24 age group, who demonstrate an endorsement rate of 16.54%. Complete reliance on RES is endorsed the least (8.66%) by respondents aged over 55.

43.70% of the RES endorsers are university graduates while 32.68% have high school degrees. The rate of the respondents without a degree but can read and write is 0.79% while the rates for those holding a master or PhD degree are 8.07% and 1.97% respectively. The percentage of respondents holding a primary school degree is 3.35%, and the percentage of middle school graduates is 9.45%.

According to RES endorsers:
83.66% would still endorse RES even in the case of an increase in their electricity bills.
87% think that RES are not adequately exploited in meeting Turkey's electricity demand.
85.24% think that growing reliance on RES will decrease Turkey's foreign energy dependence.
74.41% state that they would not be bothered by the construction of RES-based power plants in their neighbourhood.
66.73% are against the construction of HPPs due to their adverse environmental effects.

24.02% are against the construction of wind farms because of their adverse effects such as pollution, bird fatalities, and so on while 62.79% are not influenced by these effects and therefore report no opposition to wind farms.

71.06% think that Turkey's rulers fail to follow right renewable energy policies.
71.85% think that the rulers of the country do not adequately promote electricity generation through RES.
85.43% think that the nuclear energy policy followed by Turkey's rulers is wrong.

5.5. Climate change and global warming

This section discusses the public perception concerning the relationship between electricity generation and environmental problems. Table 6 presents the frequency analysis results from respondent ratings.

As can be seen in Table 6, NPPs were rated to have the highest effect on climate change. RES-based power plants such as wind and solar power plants were ranked as having the least effect on climate change.

Respondents were asked to evaluate the contributions of different types of power plants to combat climate change. A very large percentage (80.50%) of the respondents think that RES-based power plants will contribute the most to climate change mitigation. Natural gas-fired power plants were selected as the second (46.10%) in contributing to climate change mitigation, and HPPs ranked as the third (41%). However, about 40% of the respondents do not think that HPPs will help to mitigate climate change. In the light of

Table 5
Opinions of the respondents on what should be the prime consideration in electricity generation process.

			"Using only renewable energy resources is adequate in meeting Turkey's electricity demand."					Total
			Strongly disagree	Disagree	I do not have an idea	Agree	Strongly agree	
"Which one of the following do you think should be the prime consideration in electricity generation."	"The effects of electricity generation on climate change should be the prime consideration."	Frequency	90	126	171	166	342	895
		Row (%)	10.10%	14.10%	19.10%	18.50%	38.20%	100.00%
		Column (%)	49.70%	64.30%	67.60%	73.10%	79.00%	69.40%
	"Generating electricity at a low cost should be the prime consideration."	Frequency	24	22	31	11	28	116
		Row (%)	20.70%	19.00%	26.70%	9.50%	24.10%	100.00%
		Column (%)	13.30%	11.20%	12.30%	4.80%	6.50%	9.00%
	"Reducing foreign energy dependence should be the prime consideration."	Frequency	67	48	51	50	63	279
		Row (%)	24.00%	17.20%	18.30%	17.90%	22.60%	100.00%
		Column (%)	37.00%	24.50%	20.20%	22.00%	14.50%	21.60%
Total		Frequency	181	196	253	227	433	1290
		Row (%)	14.00%	15.20%	19.60%	17.60%	33.60%	100.00%
		Column (%)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

this divergence, by using a chi-square test, a regional analysis was carried out as to the opinions of the respondents on the contribution of HPPs to climate change mitigation. The significance level of the test was $p < 0.05$, which indicates a statistically significant relationship between geographical region and opinions on HPP contribution to mitigating the climate change. 46.40% of the respondents from northeastern cities, where construction of HPPs aroused national-level public reaction, do not think that HPPs help to achieve climate change mitigation. The percentages of the respondents who hold this view are 52.90% in the Mediterranean city of Mersin.

NPPs are thought to contribute the least to climate change mitigation. While 19.90% think that NPPs would contribute to climate change mitigation, 60.50% do not think they would. Respondents have a similar perspective on oil-fired power plants vis-à-vis climate change mitigation. 59.40% of the respondents think oil-fired power plants will have no contribution to climate change mitigation.

In order to find out the respondents' familiarity with particular concepts concerning electricity generation and climate change, the respondents were presented with 18 terms and asked if they had knowledge of each term. Responses were elicited through descriptive rating scale (respondents ticked the concepts of which they had knowledge). Fig. 1 presents the stated-level of knowledge of the respondents.

Respondents were also presented with a number of measures that they could take in their daily lives against climate change and global warming and asked which one of those measures they took. Responses were elicited through descriptive rating scale (respondents ticked the measures they took). Fig. 2 presents the percentages of the measures respondents stated they took.

One of the aims of the survey was to determine the level of knowledge on climate change and global warming. In addition to the overall sample, two groups of respondents were scrutinised concerning their level of knowledge of climate change and global warming: "RES endorsers" and those who answered the question "Do you support the construction of a nuclear power plant in Turkey?". To that aim, respondents were shown 18 terms and asked if they had knowledge of the terms. 1 point was assigned for each term the respondents stated that they had knowledge of. Table 7 presents the findings.

The survey also aimed to determine the level of the measures that the overall sample and two particular groups of respondents took in their daily lives against climate change and global warming (Fig. 2). These two groups were the respondents defined as "RES endorsers" and those who answered the question "Do you endorse the construction of a nuclear power plant in Turkey?". Each measure that the respondents stated they took was rated 1 point. As presented in Table 7, RES endorsers ranked the highest in terms of the measures they took against climate change and global warming. Also, this group is knowledgeable about the 18 terms related to electricity generation.

6. Conclusion

Findings of the study show that the respondents ranked RES as their top choice in electricity generation. Endorsers of RES think that thanks to RES foreign energy dependence would decrease and environmental problems such as climate change and global warming would be mitigated. These findings resonate with the existing literature [1,2,4,5,7,8,10,11,16,17]. Level of opposition to NPPs is high among the endorsers of RES. The most preferred RES-based plant types are wind and solar power plants. These two are followed by HPPs, which are unpopular and therefore aroused public opposition in several parts of the country. NPPs are indicated as the second choice, after all RES-based plants, in reducing foreign energy dependence while coal-fired plants are preferred the least.

A large majority (69.40%) of the respondents indicated that the effects on climate change should be the prime consideration in electricity generation. Both RES endorsers and NPP endorsers think that environmental degradation should be avoided while generating electricity.

Opposition to NPP construction in Turkey is high (70.20%). Opposition seems to have increased when compared to previous studies [1,4,5]. While the level of opposition is high in all cities, it is the highest in Mersin, where an NPP was in the process of

Table 6
Effects of different types of power plants on climate change.

	Coal-fired	Natural gas-fired	Oil -fired	HPPs	RES-based (such as wind and solar)	NPPs
Mean	3.04	2.30	2.99	2.48	1.55	3.18
Median	3.00	2.00	3.00	3.00	1.00	4.00
Total	3925	2973	3855	3197	2002	4098

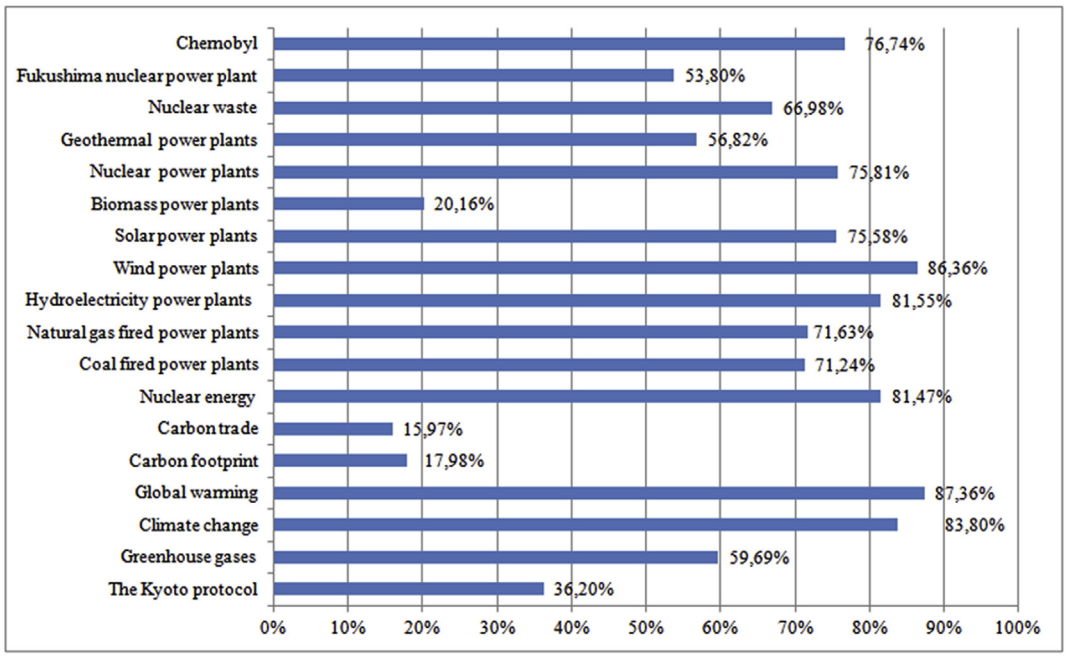
Chemobyl 76,74%
Fukushima nuclear power plant 53,80%
Nuclear waste 66,98%
Geothermal power plants 56,82%
Nuclear power plants 75,81%
Biomass power plants 20,16%
Solar power plants 75,58%
Wind power plants 86,36%
Hydroelectricity power plants 81,55%
Natural gas fired power plants 71,63%
Coal fired power plants 71,24%
Nuclear energy 81,47%
Carbon trade 15,97%
Carbon footprint 17,98%
Global warming 87,36%
Climate change 83,80%
Greenhouse gases 59,69%
The Kyoto protocol 36,20%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Fig. 1. Respondents' level of knowledge concerning electricity generation and climate change.

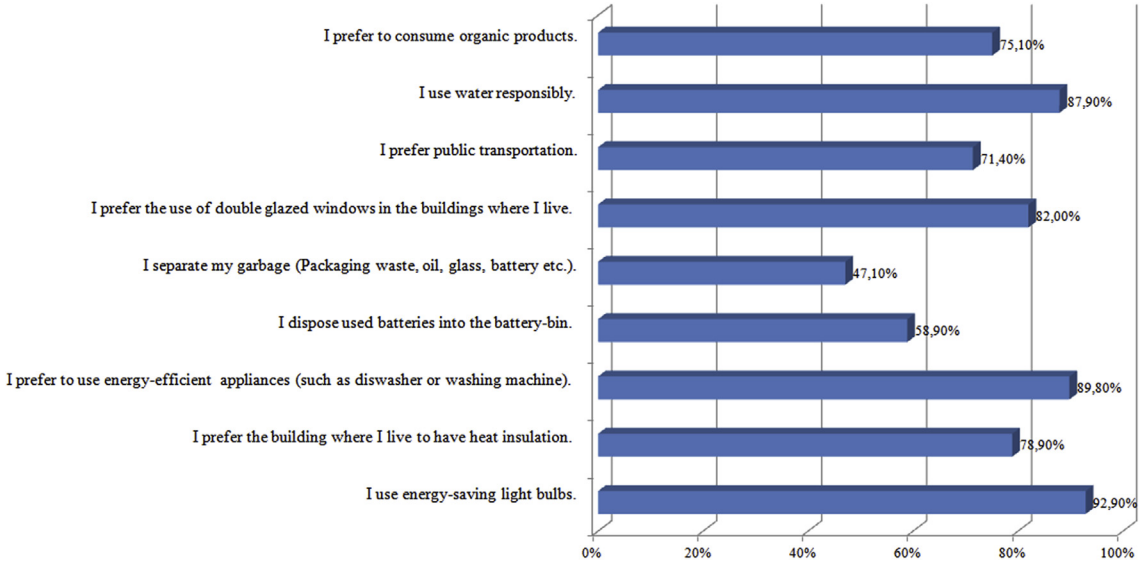
I prefer to consume organic products. 75,10%
I use water responsibly. 87,90%
I prefer public transportation. 71,40%
I prefer the use of double glazed windows in the buildings where I live. 82,00%
I separate my garbage (Packaging waste, oil, glass, battery etc.). 47,10%
I dispose used batteries into the battery-bin. 58,90%
I prefer to use energy-efficient appliances (such as diswasher or washing machine). 89,80%
I prefer the building where I live to have heat insulation. 78,90%
I use energy-saving light bulbs. 92,90%
0% 20% 40% 60% 80% 100%

Fig. 2. Percentage of daily life measures taken by respondents against climate change and global warming.

construction by the time of this study.

Opposition to NPPs is higher among the respondents who think that domestic (coal) sources and non-hydro RES (such as wind, solar, etc.) are adequate for meeting Turkey's electricity demand. Respondents opposing the construction of an NPP in Turkey were found to be more knowledgeable about the concepts related to

Table 7
Attitudes and behaviours of the respondents concerning electricity generation, climate change, and global warming.

	Mean value				
	RES endorsers	Respondents opposing NPPs	Overall sample	NPP endorsers	Respondents with no idea about NPP construction
Being knowledgeable about 18 terms related to electricity generation and climate change (Fig. 1)	12.41	11.76	11.19	10.71	8.36
Applying certain daily-life measures to help mitigate climate change and global warming (Fig. 2)	7.17	6.98	6.84	6.57	6.41

electricity generation and climate change than the respondents who endorsed NPP construction and those who did not have an idea. Respondents opposing NPP construction in Turkey were also found to take more daily-life measures against climate change and global warming than those who endorsed NPP and those who did not have an idea about the issue.

Opposition to NPPs is higher among the female respondents than males. This finding is consistent with the findings of previous studies [8,11]. Opposition to NPPs is high across all age groups. However, in contrast to literature [6,8,11], endorsement rate is higher among 15–18 age group than 41–54 and above-55 age group. Also, 15–18 age group accounts for the highest share of the respondents who say they do not have an idea regarding NPP construction. No statistically significant relationship was found between income and opposition to NPPs.

A large majority of the respondents oppose the construction of an NPP in their neighbourhood. Also, the majority of the respondents who endorse NPP construction in Turkey oppose the construction in their neighbourhood. It was found that the endorsers of NPP construction show no significant support for the nuclear energy policies pursued by the rulers of the country.

Consistent with the literature [1,6,10], respondents who endorse NPP construction in Turkey indicate that NPPs would decrease current account deficit and foreign energy dependence and contribute to climate change mitigation. However, NPP endorsers are concerned about nuclear waste disposal, safety measures, accident risks, and having the required knowledge and technology. Trust in the rulers of the country is low in terms of their ability to take the necessary steps to alleviate their concerns. Endorsers of NPPs see these plants as a sign of economic and industrial development. This finding resonates with Melikoglu's study [46]. Also, respondents who endorse NPPs do so on the grounds that they do not believe that RES-based plants will suffice to meet Turkey's electricity demand.

The majority of the respondents who opposed NPP construction in Turkey (80.46%) and who did not have an idea on the issue (40%) stated that Chernobyl and Fukushima accidents changed their views on NPPs in a negative direction while the accidents did not significantly change the views of the NPP endorses.

According to 30.30% of the respondents who endorse NPP construction in Turkey and 69.80% who oppose it, having an NPP would give rise to nuclear proliferation risk. In a previous study [4], it was found that 23.6% of the respondents thought that having an NPP would result in nuclear proliferation risk.

This study has found endorsers of RES to be 40%. In two previous studies [1,4] endorsement rates for RES were found to be 70% and 84.2% respectively. The value 40% found by this study should not be misleading since the 40% RES endorsers in this study have been defined as those who endorse 100% reliance on RES for electricity generation. Therefore, this group of respondents can be considered as a relatively informed group.

The majority of the RES endorsers are in 25–40 age group. Endorsement of RES decreases proportionately for the age groups younger and older than 25–40 age group. Endorsement of RES decreases as level of education goes below holding a graduate degree (High school, middle school, primary school, can-read-and-write). Lower support for RES by the young respondents and respondents with lower level of education can be explained by the role of media coverage and political ideas. Another reason can be respondents' lacking extensive knowledge about electricity generation.

Similar to the results of the existing body of literature, the majority of the RES endorsers in this study think that renewable energies are not adequately exploited in meeting Turkey's electricity demand and that they are willing to pay more for electricity in case of the promotion of RES.

Although support for RES in electricity generation is high, respondents have various reservations about HPPs, and endorsement of HPPs is less than that of other types of RES-based power plants. Also, RES-based power plants are seen as the most effective in contributing to climate change mitigation. RES endorsers oppose HPPs due to environmental concerns. The respondents rated the effect of HPPs on climate change to be higher than the effect of natural gas-fired power plants. In a 2011 study [4], it was found that for electricity generation natural gas-fired plants were preferred by a higher number of respondents than HPPs were preferred. The rate of the respondents who think that HPPs would contribute to climate change mitigation and the rate of those who disagree are balanced. Public opposition to HPPs has increased recently, particularly in the northeast of Turkey. Local villagers have resisted HPP projects, arguing that decreases in the supply of water threaten their livelihoods. Decreasing water levels in the river basin pose serious economic and environmental problems.

Consistent with the existing literature, a large majority of the RES endorsers state that they would not be bothered by the construction of a RES-based plant in their surrounding. Moreover, adverse effects of wind farms such as noise and bird fatalities do not constitute a major deterrent to endorsing wind farms, and therefore majority of RES supporters do not oppose wind farms.

A large majority of the RES endorsers do not think that the rulers of the country are pursuing right renewable and nuclear energy policies. Also, this group thinks that the rulers do not adequately promote RES.

RES supporters are the most knowledgeable about the concepts related to electricity generation and climate change, and they take more measures in their daily lives against climate change and global warming than other groups do.

Natural gas-fired power plants were rated to have less impact on climate change than HPPs and to contribute more to climate change mitigation. This result is consistent with a 2011 study [4] which found that the respondents were more likely to prefer natural gas-fired plants than HPPs.

The three group of respondents (endorsers of NPPs, opposers, and those with no idea) all think that NPPs' impact on climate change should be the prime concern in electricity generation. The respondents ranked NPPs as the first in contributing to climate change while HPPs were rated to have more effect on climate change than natural gas-fired plants (the same effect level was thought to be the case for coal-fired plants). These answers point to a lack of basic knowledge concerning electricity generation and its environmental effects.

7. Policy recommendations

Taking into consideration the strong public opposition to NPPs, Turkey should stop its plans to build NPPs, which have been under consideration for the past forty years. Even a significant percentage of those who endorse NPP construction in Turkey oppose the construction of an NPP in their surrounding. In addition to the adversities that have already been mentioned, a country having an NPP in the Middle East, where turmoil prevails, will be prone to threat in case of a conflict or sabotage, which would give rise to irremediable social and economic consequences.

One of the most important reasons why NPP endorsers in Turkey support NPPs is that they think RES-based plants will fall short of meeting the electricity demand of the country. Several respondents expressed in the comments section that they believed NPPs to be a political preference rather than a technical necessity. General public perception is that natural gas-fired power plants produce clean energy. This perception might be the result of

extreme air pollution from which the citizens suffered for decades due to low quality coal used by households. Public's perception on natural-gas fired plants and support for NPPs would change by raising public awareness on RES. In order to raise awareness of RES, national information centers on RES should be established by financial support of the government. Curricula should be updated and subjects intended to raise energy awareness should be included in the curricula to address the respondents' lack of knowledge and their ill-informed opinions concerning primary energy sources and power generation technologies.

The high RES potential in Turkey is not adequately exploited except for hydropower. In the light of all the aforementioned studies [9,11,12,14,16] on the factors affecting citizens' energy preferences, it is highly crucial that policies on RES be revisited. Studies in these areas would contribute to generating further support for RES, thereby weakening one of the arguments or rationales for NPPs. Carbon prices should be set in Turkey through an effective deployment of market-based mechanisms. To that end, carbon tax should be levied and the volume of voluntary emissions trading should be increased. With the help of such measures, it would be possible to minimize negative environmental impacts of electricity generation.

Implemented by the Turkish government since 2013, Partnership for Market Readiness (PMR) is a World Bank-supported technical assistance program aiming at researching the applicability of carbon taxation and emissions trading mechanisms in Turkey. The outcomes of the project will make it possible to determine whether market-based emissions reduction mechanisms such as carbon tax and emissions trading are viable in Turkey [47]. Turkey, which is a developing country, needs to introduce carbon taxation and emissions trading system if it wants to limit its increasing GHG emission values, reduce the environmental and social costs of fossil fuels, and realise energy transition. Adopting a carbon tax would increase the competitiveness of RES-based power plants in comparison to domestic lignite-fired power plants, which rely on a high-carbon source. This would in turn increase the rate of reliance on Turkey's substantial potential for RES [48–50]. Setting the right amount for carbon tax in Turkey is crucial to the success of the country's carbon taxation mechanism. The amount for tax should not hamper economic growth. It should also be remembered that setting an amount that is the same with or close to levels adopted by developed countries would run the risk of arousing public reaction and consequently pose a major threat to the applicability of the system [50]. The electricity generation sector is the chief sector in which carbon taxation can be adopted. Implementation of carbon taxes in this sector is highly likely to deliver the desired results in a relatively short amount of time [48,51]. Turkey's subsidies to coal mining and coal-fired power plants corresponded to 730 million USD in 2013 [52]. The policy of carbon taxation coupled with elimination of coal subsidies would result in a 7% increase in national income by 2040 and the share of renewable energies would reach 60% [53].

A large majority of the respondents stated that avoiding negative effects on climate change should be the prime consideration in electricity generation. At a time when climate change and global warming are seriously threatening the planet and contribution of coal to the two are widely discussed, as a country having rich RES potential, Turkey's commitment to utilising both coal and RES is controversial. Given that the Turkey's greenhouse gas emissions have been increasing makes the situation even more complicated. Policy decisions on establishing coal-fired power plants need to be reconsidered given that domestic coal is known for its low calorific value and high emissions.

RES-based electricity generation is one of the effective tools to combat climate change and generation from RES are becoming less costly [54]. In order to combat climate change, more financial incentives should be offered to foster RES than ever before. RES experiences in various countries show that increase in RES-based electricity generation is closely linked to economic incentives. Fostering a supportive environment for RES investments is also crucial and must accompany financial incentives. The first legal arrangement providing incentives for RES in Turkey was enacted in 2001 with the Electricity Market Law No. 4628. Known as Renewable Energy Law, Act No. 5346 on Utilisation of Renewable Energy Sources for the Purposes of Generating Electrical Energy, provided FiTs for electricity from RES. Due to the relatively low rate and shorter lifespan of FiTs compared to other countries, an amendment was introduced that differentiated the tariff payable by technology type and introduced a premium payment, dependent on utilising locally manufactured components in the project [55]. Initiated in 2013, the policy of granting additional support to local content fees for unlicensed electricity generation was abolished with an amendment in 2016.

Unlicensed electricity generation plants should also be able to qualify for domestic component subsidy fees paid for domestic component usage in the form of price additions to fixed rates. This situation would impede the production of domestic energy equipment. That licensed and unlicensed plants have to undergo very similar bureaucratic processes not only increases production costs but also prevents the expansion of plants. FiTs scheme in Turkey, which is provided for 10 years, is shorter compared to many EU countries, which typically provide it for 15 years. Renewable energy investments are also subsidized within Regional Investment Incentive Scheme, which falls under the General Investment Incentive Scheme. Various incentives and exemptions, including land allocation incentives, are granted by these schemes [55,56].

MENR introduced RES Zones (RE-Zones) model in 2016 in order to promote renewable energy investments, utilisation of locally-manufactured components in the plants and technology transfer-based R&D activities. With the decreasing costs of electricity generation from RES, auction system in RE-Zone projects has become a widely used incentive mechanism for developed and developing countries. Auction system is usually implemented in conjunction with other incentive mechanisms and has attracted a great deal of interest thanks to the competitive atmosphere and the concomitant decreased prices it offers. Prices shaped by wind and solar auctions maintain the declining trend [57]. Incentive mechanisms that involve the use of FiT and auctions in conjunction with one another are promising since they offer lower prices and increased installed power [58]. As part of RE-Zones, two auctions have been conducted for the construction of photovoltaics (PV) and wind power plants with 1 GW installed power capacity each. The bid prices received in the auctions were far lower than those given by support mechanism and bids received in the wind power auction were lower than the average market price during that period. In July 2018, Greece held its first regular competitive auctions for renewable energies. Prices reached in the auctions were higher than those in Turkey's auctions. Prices in Turkey's auctions have shown that not only generating electricity from RES can mitigate climate change but also electricity from RES can be generated at lower costs. Auction results suggest that energy costs in Turkey will be lowered in the ling run.

Among the positive developments are incentives provided for rooftop and facade PV systems of up to 10 kW and exempting excess generation from income tax through Renewable Energy Support Mechanism (RESM). This change has decreased the production costs and facilitated the running of the system. In accordance with the recent regulations, applications for power plants up to 3 kW are entitled to make a connection agreement directly and granted a call letter immediately after the application. Capacity restrictions

stemming from the transformer centers have been lifted for the installment of residential and workplace solar panels with a maximum capacity of 3 kW [59,60]. Extending the "premium for use of domestic equipment" scheme, which is currently granted to licensed plants, to the facilities of up to 10 kW for a period of five years would encourage the use of renewable energy for self-consumption.

MENR has stated that the RESM will no longer be effective by the end of 2020. RES incentives should be maintained. An important concern with the new incentive mechanisms will be which energy sources they are to cover and how they should be implemented depending on the way resources are utilised. Different incentive mechanisms should be adopted for solar energy systems placed on roofs and the large-scale PV systems. Municipalities should reduce taxes. For example, reductions on municipal solid waste and environment tax can be granted to households or businesses that use RES. Extended periods of licensing and authorization form significant barriers to RES investments and development of RES projects. Also, these processes increase the Levelized Cost of Generating Electricity (LCOE) for RES in Turkey in comparison to many other countries.

In order to increase financial incentives for RES the share in electricity bills allocated to Turkish Radio and Television Institute (TRT) should be diverted to RES, and this share should be defined as RES share. It has been a matter of public debate for so long whether or not TRT share in electricity bills should be lifted. Despite the numerous court cases filed against the TRT share and laws proposed in the national assembly for its removal, governments have refused to make any changes. Contributing the funds from electricity bills to investments in which the members of the society have equal stake would be a wiser policy than contributing them to an institution that is in no way linked to electricity production. Diverting TRT share to RES investments would be a significant incentive at a time when Turkey's increasing GHG emissions and global effects of climate change are two important issues. Different countries have adopted different policies to address this issue. For instance, Germany has been implementing Renewable Energy Act (EEG)-surcharge since 2000 [61]. Belgium has electricity excise tax to finance its offshore wind farms [62].

About 40% of the respondents in this study have expressed that they would keep endorsing RES despite an increase in their electricity bills. Given this finding, TRT share in electricity bills needs to be diverted to RES-based electricity generation, which would be a public investment serving the entire public.

Indirect taxes collected in the form of fees and funds could also be allocated to the promotion of RES. The funds generated should be used in subsidising RES for household self-consumption. Self-consumption with RES should be increased in order to promote unlicensed small-scale generation. In this respect, PV is a promising technology. Revenues collected in the RES fund should be used to provide incentives for the investments in PV self-consumption, starting with household generation. These incentives can be in the form of subsidising PV system instalments or offering long-term, no-interest repayment schemes.

The criteria that must be met by wind and PV systems with parallel grid connection have been described by the Electricity Market Grid Regulation, Annex-18 [63]. In Turkey, considerable amount of work has been done so far on grid systems as well as their connection of wind and PV units. It would be possible to generate 20% of Turkey's total electricity production from wind and solar energy by 2026 without incurring additional expenditures or creating managerial and planning-related burden on the country's existing transmission system plans [38]. Considering the present structure of Turkish grid, it can be said that the present and planned wind farms are far from posing a threat to the system stability, security or power quality [64]. In parallel with the developments in wind turbine technologies, flexible control of active and reactive power has become possible and mechanical strains and power penetration levels have been decreased. The effects of wind turbines on grids have decreased with the introduction of synchronous generators and power electronics systems [65–69]. According to the existing Grid Code, wind plants are required to operate in active and reactive power control and help with maintaining the balance of the power system by contributing to it in the case of disturbances. Assessment of long-term wind data is crucial to the expansion of system capacity [67]. An important development in this regard has been the regulation on connecting all licensed wind power plants above 10 MW to the Wind Monitoring and Prediction Center as it is expected to facilitate the large-scale integration of wind power plants to the Turkish electricity system [70]. The most important problem encountered during the connection of PV power plants to the grid is caused by selection of inaccurate performance criteria for the inverters. Grid-connected inverters used in PV power plants must be selected carefully in terms of their harmonic disturbance values. The harmonic current of grid-connected PV systems and the power factor should be below specified levels and the current should not be diverted to the grid. An appropriately selected inverter is the chief guarantor of power quality throughout the entire lifecycle of solar power system [71].

Decision-making and other processes regarding HPP projects should involve public participation. Seeking public consensus prior to HPP project developments is essential in order to achieve renewable energy generation that preserves natural resources and maintains the ecological balance.

Considering the high level of WTP for increased RES-based generation, licensing and then labelling the goods and services produced by RES should be considered. With the aim of promoting RES-based generation, RES license labels can be used in financing the projects carried out by national and international non-profit organisations (foundations, associations, etc.).

Policy makers need to adopt a holistic energy approach that simultaneously addresses the issues of electricity generation problems, energy conservation and efficiency, and RES. New RES incentive mechanisms should be determined with the joint work of Turkey's MENR, Ministry of Environment and Urban Planning, Ministry of Economy, NGOs, and other stakeholders. In this way, it would be possible to come up with policies that take into account the environmental, economic, and societal priorities. Support for R&D and innovation investments should be increased. The cumulative effect of these efforts will decrease RES investment costs as well as current account deficit and contribute to an increase in RES deployments.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.renene.2018.08.006.

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